

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
28 March 2002 (28.03.2002)

PCT

(10) International Publication Number  
**WO 02/24487 A1**

(51) International Patent Classification<sup>7</sup>: **B60R 19/22**

(21) International Application Number: **PCT/SE01/02003**

(22) International Filing Date:  
19 September 2001 (19.09.2001)

(25) Filing Language: **English**

(26) Publication Language: **English**

(30) Priority Data:  
0003418-1 19 September 2000 (19.09.2000) **SE**

(71) Applicant (for all designated States except US): **SSAB  
HARDTECH AB** [SE/SE]; S-971 88 Luleå (SE).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **JONSSON, Martin**  
[SE/SE]; Östra Järnvägsplanaden 6, S-972 42 Luleå (SE).

(74) Agent: **ÅSLUND, Roland**; SSAB Hardtech AB, S-971 88  
Luleå (SE).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

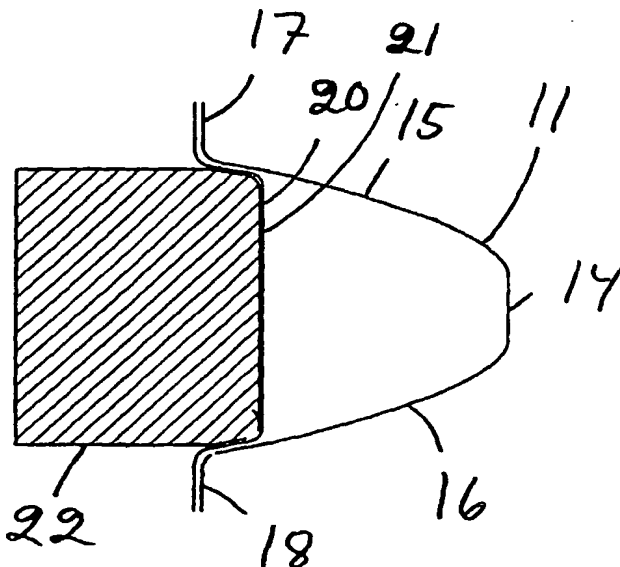
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **A BUMPER FOR A VEHICLE**



(57) Abstract: A bumper comprises a hat beam (11) adapted to have its crown directed towards the vehicle body, a cover (20) attached to the side flanges (17, 18) of the hat beam and having a longitudinal recess (21) that extends into the hat beam, and an energy absorbing foamed body (22) that fills out the recess and extends with its major part out of the recess. If the foamed body widens out over the side flanges (17, 18) of the hat beam, these widened parts (35-27) should have recesses (28-31) that prevent these parts to be fully compacted before the part therebetween is compacted if the bumper hits a pedestrians leg.

WO 02/24487 A1

## A bumper for a vehicle

### Technical field

This invention relates to a bumper for a vehicle, comprising a hat beam adapted to have its crown directed towards the vehicle body, a cover attached to the side flanges of the hat beam and having a longitudinal recess that extends into the hat beam to a depth of between  $1/10$  and  $1/3$  of the profile height of the hat beam, and an energy absorbing foamed body that fills out the recess and extends out of the recess so that 65 – 85 % of the depth of the foamed body is outside the hat beam.

### Brief description of prior art

A bumper of this kind is known from WO 9920490. The foamed body is used to absorb energy by being compressed before the hat beam will be deformed to take up energy. The foamed body extends over the side flanges of the hat beam and the front surface of the foamed body is almost flat so that, if the bumper hits a barrier, the foam will be compressed to compactness on the side flanges and will become totally stiff while the foam therebetween will still be resilient. The foam in the middle cannot be compacted to stiffness until the beam itself has been deformed. In the above-mentioned publication, a modified bumper is also shown which has a flat cover and the foam will therefore give a more uniform resistance force when compressed.

### Object of invention and brief description of the invention

It is an object of the invention to provide a bumper beam with a foamed body that gives a more uniform load vertically on an object that is hit, for example the legs of a pedestrian, combined with a reduced horizontal extension of the entire bumper for a given strength. To this end, the part of the foamed body that extends out of the hat beam has either at most the same area as in the recess or alternatively it widens out over the side flanges and has recesses that reduce the difference in compactness to be less than 15 % when the

bumper hits a vertical pillar and any part of the foamed body is compressed to total compactness.

### **Brief description of the drawings**

- Figure 1 shows as an example of the invention a bumper beam seen from above.
- Figure 2 is a transverse section taken along line 2-2 in figure 1.
- Figure 3 corresponds to figure 2 but it shows a modified design.
- Figure 4 is a view taken as indicated by the arrows 4-4 in figure 3.
- Figure 5 corresponds to figure 2 but shows still another modified design.

### **Description of preferred embodiments of the invention**

Figure 1 shows a bumper beam 10 which is fastened to two crash boxes 12,13 and the crash boxes are fastened to the vehicle body, for example to the front ends of the side rails (side beams). The bumper beam 10 is formed from sheet steel and it comprises a so-called hat beam 11 and a cover 20 as can be seen in figure 2. The hat beam 11 has a crown that comprises a top 14 (top flange) and two flanks 15,16. The flanks end in side flanges 17,18. The bumper beam is fastened in the two crash boxes 12,13 with its crown directed towards the vehicle body, for example the body of a passenger car.

The cover 20 is fastened, for example spot-welded, to the side flanges 17,18. It has a recess 21 into the beam 11 and the recess fills the entire profile width of the beam. The recess 21 has a flat bottom. A comparatively stiff foamed body 22 of an elastomeric material (a foam beam) fills the entire width of the recess and it is fastened to the bottom of the recess 21. The recess 21 extends into the hat beam 11 to a depth of between 1/10 and 1/3 of the depth (the profile height) of the hat beam and such a recess has only a minor influence on the strength of the closed beam 11,20. The energy absorbing foamed body 22 fills out the recess 21 and extends out of the recess so that 65 – 85 % of the depth of the foamed body is outside the hat beam. The foamed body

must reach full compactness before its front end reaches the level of the side flanges 17,18 when it is compressed. Otherwise the area of the two side flanges would be the only force-taking surface when the foamed body has been compressed to the level of the side flanges. When a pedestrian has been hit, this sudden reduction of the energy-absorbing surface would increase the injuries.

The recess 21 in the cover 20 will have only a minor influence on the strength of the beam 11,20 but it will make it possible to reduce the horizontal width of the entire bumper since the major part of the foamed body will be inside the beam 11,20. If the horizontal length available for the bumper is limited, which is usually the case, this reduction in the length of the foamed body outside the beam can be used to make the beam 11,20 bigger and thus increase the strength of the bumper without increasing the injuries of a pedestrian hit by the car.

Figures 3 and 4 show a modified foamed body 22 that widens and extends out over the side flanges 17,18. This is advantageous since it increases the vertical extension of the foam, which reduces the load on the legs of a pedestrian hit by the car. The two widened parts 26,27 of the foamed body adjacent the side flanges 17,18 have three rows of recesses 28,29 30 so that the part of the foamed body adjacent the recess 21 in the cover 20 will be compressed to full compactness before the parts 26,27 adjacent the side flanges are compressed to full compactness when the bumper hits for instance a vertical pillar or a flat barrier or a pedestrians leg. The recesses 28-30 are separated by thin partitions 24, which make the parts 26,27 comparatively stiff.

Figure 5 shows a foamed body, which is modified from the one in figures 3 and 4 in that it has only one row of recesses 31 instead of a number of rows as the one in figures 3 and 4. In this design, the partitions may be omitted

since the foamed body will have a T-formed transverse section with a comparatively thick and strong flange 25

A foam suitable for use in all the embodiments may have about 30 % of its original volume when compressed to full compactness and the dimensions in the designs of figures 3-5 should be such that the difference in compactness vertically should be less than 15% in the foamed body when any part of the foam reaches full compactness when the bumper hits a pedestrians leg which can be considered as a vertical pillar. Preferably, the main part of the foamed body, that is, the part adjacent the recess 21 in the cover 20, should be fully compacted before or simultaneously with the parts adjacent the side flanges 17,18. In the design of figure 2, it is important that the foam reaches full compactness while it extends out of the beam; otherwise, the load-taking surface will be reduced to the area of the two side flanges 17,18 when the front surface of the foamed body reaches the level of the flanges during the compression of the foamed body.

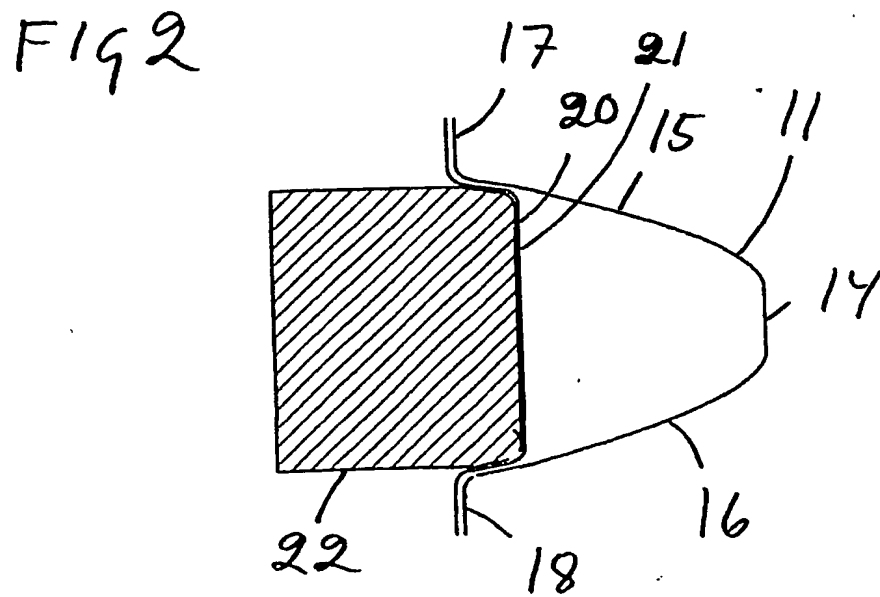
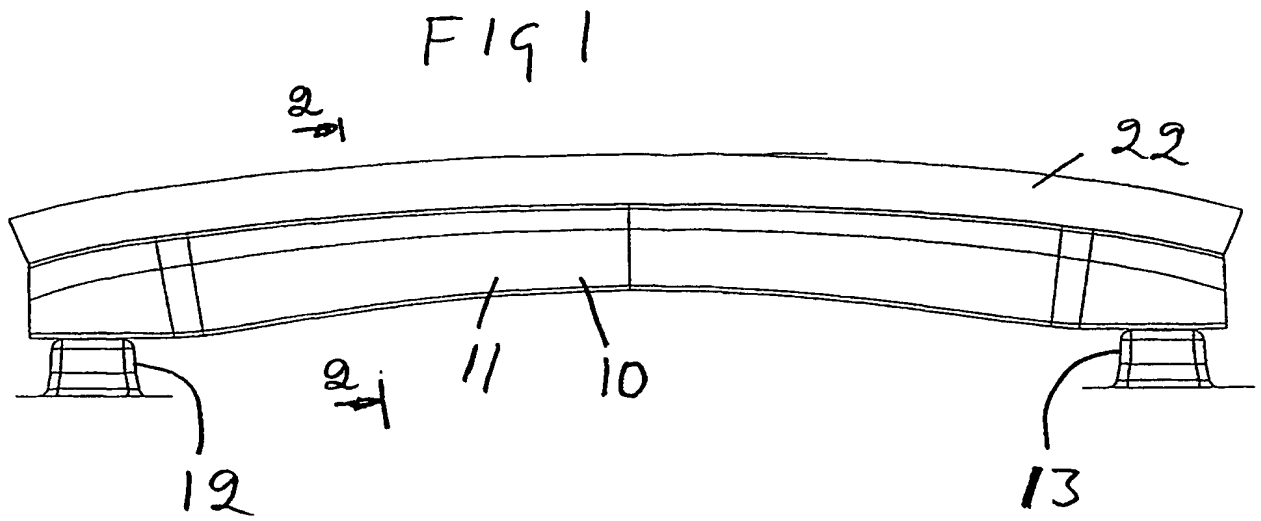
## Claims

1. A bumper for a vehicle, comprising a hat beam (11) adapted to have its crown (14-16) directed towards the vehicle body, a cover (20) attached to the side flanges (17,18) of the hat beam and having a longitudinal recess (21) that extends into the hat beam to a depth of between 1/10 and 1/3 of the profile height of the hat beam, and an energy absorbing foamed body (22) that fills out the recess and extends out of the recess so that 65 – 85 % of the depth of the foamed body is outside the hat beam,

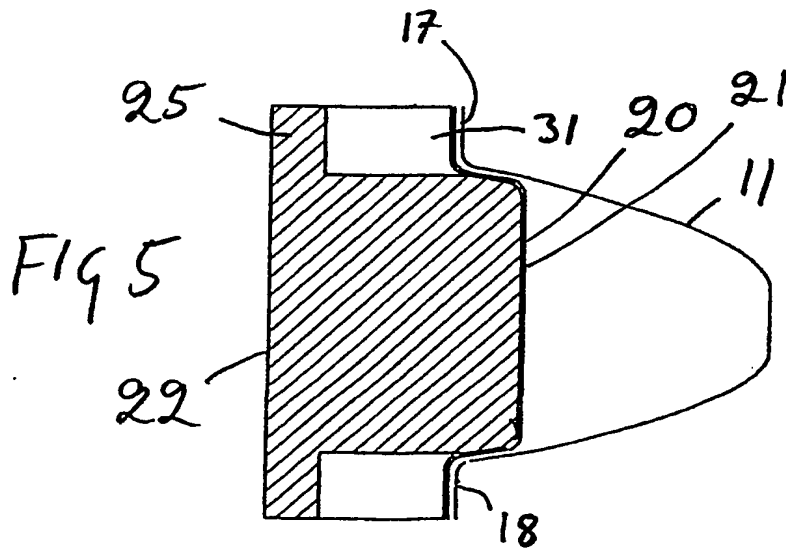
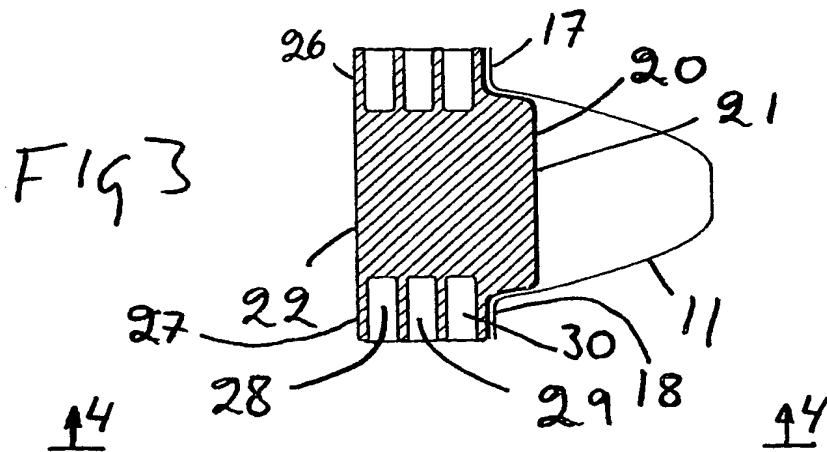
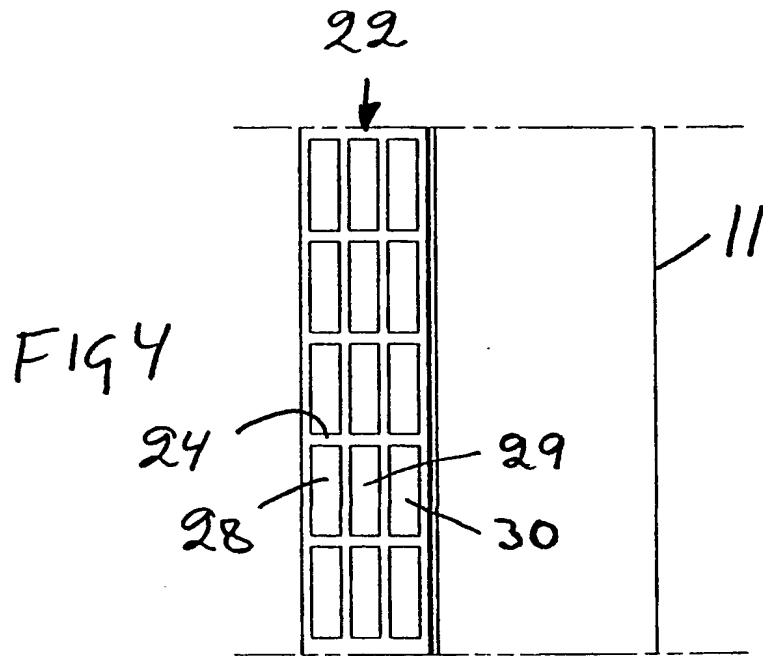
**characterised in**

that the part of the foamed body (22) that extends out of the hat beam either has at most the same area as in the recess (21) in the cover or alternatively widens out over the side flanges and has recesses (28-30;31) in the widened parts (25; 26,27) that reduce the difference in compactness along a vertical line to be less than 15 % when the bumper hits a vertical pillar and any part of the foamed body is compressed to total compactness.

2. A bumper according to claim 1, **characterised in** that the recesses (28-31) in the foamed body are so dimensioned that the foamed body adjacent the recess (21) in the cover (20) is compressed to full compactness before the widened parts (25; 26,27) of the foamed body are compressed to full compactness.







## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 01/02003

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B60R 19/22

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                      | Relevant to claim No. |
|-----------|---|-----------------------|
| Y         | WO 9920490 A1 (SSAB HARDTECH AB), 29 April 1999<br>(29.04.99), page 4, line 16 - line 23, figure 7<br>--                | 1                     |
| Y         | US 4018466 A (S.I. NORLIN), 19 April 1977<br>(19.04.77), column 2, line 64 - column 3, line 40,<br>figure 3<br>--       | 1                     |
| A         | DE 4341884 A1 (SAAB AUTOMOBILE AB), 23 June 1994<br>(23.06.94), column 4, line 3 - line 17, figure 1,<br>abstract<br>-- | 1,2                   |

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

20 December 2001

Date of mailing of the international search report

09-01-2002

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Authorized officer

Hans Nordström / MRo  
Telephone No. +46 8 782 25 00

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 01/02003

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                    | Relevant to claim No. |
|-----------|---|-----------------------|
| A         | GB 2081653 A (EX-CELL-O CORPORATION),<br>24 February 1982 (24.02.82), figure 2,<br>abstract<br><br>-- | 1                     |
| A         | WO 9520506 A1 (PLANNJA HARDTECH AB), 3 August 1995<br>(03.08.95)<br><br>--<br>-----                   | 1                     |

Form PCT/ISA/210 (continuation of second sheet) (July 1998)

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

06/11/01

International application No.

PCT/SE 01/02003

| Patent document cited in search report |         |    | Publication date | Patent family member(s) |             | Publication date |
|--|---------|----|------------------|-------------------------|-------------|------------------|
| WO                                     | 9920490 | A1 | 29/04/99         | EP                      | 1027231 A   | 16/08/00         |
|  |         |    |                  | SE                      | 509041 C    | 30/11/98         |
|  |         |    |                  | SE                      | 9703859 A   | 30/11/98         |
| US                                     | 4018466 | A  | 19/04/77         | DE                      | 2118502 A   | 11/11/71         |
|  |         |    |                  | FR                      | 2089868 A   | 07/01/72         |
|  |         |    |                  | GB                      | 1338138 A   | 21/11/73         |
|  |         |    |                  | JP                      | 55006532 B  | 18/02/80         |
|  |         |    |                  | SE                      | 346267 B    | 03/07/72         |
|  |         |    |                  | US                      | 3901543 A   | 26/08/75         |
| DE                                     | 4341884 | A1 | 23/06/94         | GB                      | 2273472 A,B | 22/06/94         |
|  |         |    |                  | GB                      | 9324242 D   | 00/00/00         |
|  |         |    |                  | JP                      | 7017340 A   | 20/01/95         |
|  |         |    |                  | SE                      | 502966 C    | 04/03/96         |
|  |         |    |                  | SE                      | 9203837 A   | 22/06/94         |
|  |         |    |                  | US                      | 5498044 A   | 12/03/96         |
| GB                                     | 2081653 | A  | 24/02/82         | AU                      | 526805 B    | 03/02/83         |
|  |         |    |                  | AU                      | 6895781 A   | 21/01/82         |
|  |         |    |                  | CA                      | 1156289 A   | 01/11/83         |
|  |         |    |                  | DE                      | 3125137 A,C | 04/03/82         |
|  |         |    |                  | FR                      | 2486473 A,B | 15/01/82         |
|  |         |    |                  | IT                      | 1142678 B   | 15/10/86         |
|  |         |    |                  | IT                      | 8148566 D   | 00/00/00         |
|  |         |    |                  | JP                      | 1296190 C   | 26/12/85         |
|  |         |    |                  | JP                      | 57047234 A  | 18/03/82         |
|  |         |    |                  | JP                      | 60020216 B  | 21/05/85         |
|  |         |    |                  | MX                      | 151996 A    | 23/05/85         |
|  |         |    |                  | US                      | 4348042 A   | 07/09/82         |
| WO                                     | 9520506 | A1 | 03/08/95         | AU                      | 1594095 A   | 15/08/95         |
|  |         |    |                  | AU                      | 6388294 A   | 11/10/94         |
|  |         |    |                  | BR                      | 9406088 A   | 13/02/96         |
|  |         |    |                  | DE                      | 19581488 T  | 02/01/97         |
|  |         |    |                  | DE                      | 69413016 D  | 00/00/00         |
|  |         |    |                  | EP                      | 0690746 A,B | 10/01/96         |
|  |         |    |                  | GB                      | 2301319 A,B | 04/12/96         |
|  |         |    |                  | GB                      | 9614522 D   | 00/00/00         |
|  |         |    |                  | SE                      | 503450 C    | 17/06/96         |
|  |         |    |                  | SE                      | 9400227 A   | 27/07/95         |
|  |         |    |                  | US                      | 5622105 A   | 22/04/97         |
|  |         |    |                  | US                      | 5722708 A   | 03/03/98         |